REMARKS

Claims 1, 3-23 are pending in the application. Claims 1, 22, and 23 are independent.

Claim Objections

Claims 1, 22, and 23 have been objected to because of some informalities.

Claims 1, 22, and 23 have been amended, as suggested by the Examiner, to overcome this objection. The Examiner is respectfully requested to reconsider and withdraw this objection.

Claim Rejections - 35 U.S.C. § 112

Claim 21 has been rejected under 35 U.S.C. § 112, first paragraph, because the specification fails to disclose an engine air-fuel ratio required to release the adsorbed NOx from the NOx catalyst in the case for a light-off catalyst with reduced O_2 storage capability is set leaner than that in the case for another light-off catalyst in which the O_2 storage capability is not reduced.

In claim 21, the "another light-off catalyst" limitation has been amended to --a three-way catalyst-- to overcome this rejection. This limitation is clearly supported at least by the statements in page 19, lines 15-25 of the specification.

IN view of this, the Examiner is respectfully requested to reconsider and withdraw this rejection.

Embodiments of the Present Invention

One of the embodiments of the present invention is directed to an exhaust gas purifying apparatus of an internal combustion engine that includes: a light-off catalyst provided in an exhaust passage and having an O_2 storage capability such that the light-off catalyst passes, therethrough, at least CO in an exhaust gas to a downstream side of the light-off catalyst when the internal combustion engine is operating under a condition where the oxygen concentration of the exhaust gas is reduced; exhaust gas purifying means provided in the exhaust passage at a downstream position of and in series with the light-off catalyst, the exhaust gas purifying means having a NOx catalyst for adsorbing NOx in the exhaust gas when an air-fuel ratio of the exhaust gas is lean and releasing the adsorbed NOx when the oxygen concentration of the exhaust gas is reduced, the exhaust gas purifying means further having a three-way catalyst that reacts with the released NOx; and control means for recovering the NOx catalyst by reducing the oxygen concentration in the exhaust gas such that the CO that has passed through said light-off catalyst is introduced to the NOx catalyst when a NOx conversion efficiency of the NOx catalyst is

decreased and maintaining the reduced oxygen concentration until the adsorbed NOx in the NOx catalyst is released.

The control means also calculates the NOx conversion efficiency after the recovery of the NOx catalyst, and regenerates the NOx catalyst to release SOx only when the NOx conversion efficiency, calculated after the recovery, is less than a threshold value.

In another embodiment, the control means switches an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to one of a stoichiometric air-fuel ratio and a rich air-fuel ratio while maintaining temperature of said NOx catalyst below a temperature in which SOx is released.

In yet another embodiment, the control means repeatedly releases NOx adsorbed by the NOx catalyst every first interval and repeatedly releases SOx adsorbed by the NOx catalyst every second interval longer than the first interval.

Claim Rejections - 35 U.S.C. § 102

(a) Claim 22 has been rejected under 35 U.S.C. § 102(e) as being anticipated by Hepburn et al. (USP 5,974,788) (Hepburn '788). This rejection is respectfully traversed.

Hepburn '788 is directed to a method and apparatus for desulfating a NOx trap. More specifically, as shown in Fig. 1,

Hepburn '788 discloses an engine 18 having an exhaust system 22. The exhaust system 22 is provided with a NOx trap 32 and a catalytic converter 26 (TWC 26) disposed between engine 18 and the NOx trap 32. As stated in col. 2, line 58 - col. 3, line 7, the TWC 26 operates at temperatures between 400 and 1000°C., the trap 32 operates in a window 32 operates in a window of 300 to 400°C., and to purge the trap of sulfur, the trap 32 must be heated to approximately 650°C. After purging is completed an electronic engine controller returns the lean mode of operation.

Hepburn '788 also states, in col. 3, lines 8-12, that an exotherm of sufficient temperature rise is created in the trap 16 [32] by modulation of the air-fuel mixture supplied to the engine cylinders through manipulation of the fuel injection quantities.

In other words, Hepburn '788 merely discloses a method and apparatus for increasing the temperature of the NOx trap 32 to about 650°C. in order to release SOx accumulated in the NOx trap, and does not disclose switching "an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio <u>while maintaining temperature of said NOx catalyst below a temperature in which SOx is released</u>," as recited in claim 22. Accordingly, Hepburn '788 does not disclose or even suggest the "control means" as recited in claim 22.

The Examiner is respectfully requested to reconsider and withdraw this rejection.

(b) Claims 22 and 23 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Murachi et al. (USP 5,746,989). This rejection is respectfully traversed.

(Claim 22)

Murachi is directed to a method for purifying exhaust gas of a diesel engine. Murachi discloses, in Fig. 1, a diesel engine 1 provided with an oxidizing catalyst 5 disposed at a downstream position of the engine 1, a diesel particulate filter (DPF) 7 provided downstream of the catalyst 5, and a NOx absorbent 9 provided downstream of the DPF 7.

The Examiner refers to the statements in col. 8, lines 43-64 of Murachi and alleges that Murachi discloses the control means as recited in claim 22 of the present application. Applicants respectfully disagree.

Murachi states, in col. 8, lines 43-64, that since the sulfate formed in the NOx absorbent is more stable than the nitrate formed by NOx, a temperature higher than the normal regenerating operation of the NOx absorbent is required to release sulfate from the absorbent, and also that the NOx absorbent 9 is regenerated at a exhaust gas temperature higher than that in the normal regenerating

operation during the regenerating operation of the DPF 7 to release sulfate as well as NOx from the NOx absorbent 9. In summary, Murachi merely states that a temperature higher than that required for releasing NOx is required when releasing sulfate from the NOx absorbent 9.

Murachi, however, does not disclose switching "an air-fuel ratio of the exhaust gas from a lean air-fuel ratio to a stoichiometric air-fuel ratio or a rich air-fuel ratio while maintaining temperature of said NOx catalyst below a temperature in which SOx is released," as recited in claim 22. Accordingly, Murachi does not disclose or even suggest the "control means" as recited in claim 22.

(Claim 23)

In page 7 of the Office Action dated August 7, 2003, the Examiner states, with respect to claim 23, that Murachi discloses "control means (20, 4) for repeatedly releasing NOx adsorbed by the NOx catalyst every first interval (2 minutes) and repeatedly releasing SOx adsorbed by the NOx catalyst every second interval (60 minutes) longer than the first interval (see Figure 5 and lines 43-64 of column 8, especially lines 57-60 of column 8)."

Applicants respectfully disagree. In Murachi, SOx is released from the NOx catalyst only when regeneration of the DPF and release of NOx take place simultaneously. Namely, SOx is released when:

exhaust gas having higher temperature is introduced into the DPF; the exhaust gas burns in the DPF which results in exhaust gas having higher temperature to be introduced into the NOx catalyst; the temperature of the exhaust gas further increases as regeneration of the NOx catalyst takes place; and the increased exhaust gas temperature allows SOx to be released. In other words, in Murachi, the SOx release control takes place only when the NOx release control and the DPF regeneration control take place at the same time. For example, as long as one of the DPF regeneration control and the NOx release control does not occur, the SOx release control will never take place.

By contrast, in the claimed invention, the SOx release control and the NOx release control may take place independently. Therefore, it is possible to release SOx even when the NOx release control is not taking place.

Further, in Murachi, because the SOx is release only when the DPF regeneration control and the NOx release control take place simultaneously, intervals at which the SOx release take place may coincide with the NOx release control interval or may be longer than the NOx release control interval as shown in Fig. 5.

In the claimed invention, however, the SOx release control interval is always set longer than the NOx release control interval.

In view of this, Murachi simply does not disclose "repeatedly releasing NOx adsorbed by the NOx catalyst every first interval and repeatedly releasing SOx adsorbed by the NOx catalyst every second interval longer than the first interval," as recited in claim 23. Accordingly, Murachi does not disclose or even suggest the "control means" as recited in claim 23.

The Examiner is respectfully requested to reconsider and withdraw this rejection.

(c) Claims 1, 8-15, and 17 have been rejected under 35 U.S.C. § 102(e) as being anticipated by Hepburn (USP 5,771,685) (Hepburn '685). This rejection is respectfully traversed.

Hepburn '685 discloses, in Fig. 1, an engine 18 having an exhaust system 22. The exhaust system 22 is provided with a NOx trap 32 and a catalytic converter 26 disposed between engine 18 and the NOx trap 32. Hepburn '685 states, in col. 6, lines 13-16 that if the NOx storage efficiency is less than a predetermined NOx storage efficiency SC_{eff}, the time period for lean operation T_1 is reduced toward T_{1c} by a predetermined amount.

Hepburn '685, however, does not calculate "the NOx conversion efficiency after the recovery," and regenerate "the NOx catalyst to release SOx only when the NOx conversion efficiency, calculated after the recovery, is less than a threshold value," as recited in

claim 1. Accordingly, Hepburn '685 does not disclose or even suggest the "control means" as recited in claim 1.

Claims 8-15, and 17, variously dependent on claim 1, are allowable at least for their dependency on claim 1.

The Examiner is respectfully requested to reconsider and withdraw this rejection.

Claim Rejections - 35 U.S.C. § 103

(a) Claims 3 and 4 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Hepburn '685 in view of design choice. This rejection is respectfully traversed.

Claims 3 and 4, variously dependent on claim 1, is allowable at least for their dependency on claim 1.

The Examiner is respectfully requested to reconsider and withdraw this rejection.

(b) Claims 5, 16, and 18 have been rejected under 35 U.S.C. § 103(a) as being unpatentable over Hepburn '685 in view of official notice. This rejection is respectfully traversed.

Claims 5, 16, and 18, variously dependent on claim 1, is allowable at least for their dependency on claim 1.

The Examiner is respectfully requested to reconsider and withdraw this rejection.

Conclusion

Accordingly, in view of the above amendments and remarks, reconsideration of the rejections and allowance of the pending claims in the present application are respectfully requested.

The Examiner is respectfully requested to enter this Reply After Final in that it raises no new issues. Alternatively, the Examiner is respectfully requested to enter this Reply After Final in that it places the application in better form for Appeal.

Should there be any outstanding matters that need to be resolved in the present application, the Examiner is respectfully requested to contact Maki Hatsumi (Reg. No. 40,417) at the telephone number of the undersigned below, to conduct an interview in an effort to expedite prosecution in connection with the present application.

If necessary, the Commissioner is hereby authorized in this, concurrent, and future replies, to charge payment or credit any overpayment to Deposit Account No. 02-2448 for any additional fees required under 37 C.F.R. §§ 1.16 or 1.17; particularly, extension of time fees.

Respectfully submitted,

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